RAIO-0518-60201

May 29, 2018

Docket No. 52-048

U.S. Nuclear Regulatory Commission
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SUBJECT: NuScale Power, LLC Response to NRC Request for Additional Information No. 403 (eRAI No. 9362) on the NuScale Design Certification Application

REFERENCE: U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 403 (eRAI No. 9362)," dated March 29, 2018

The purpose of this letter is to provide the NuScale Power, LLC (NuScale) response to the referenced NRC Request for Additional Information (RAI).

The Enclosure to this letter contains NuScale's response to the following RAI Questions from NRC eRAI No. 9362:

- 03.08.02-15
- 03.08.02-16
- 03.08.02-17

This letter and the enclosed response make no new regulatory commitments and no revisions to any existing regulatory commitments.

If you have any questions on this response, please contact Marty Bryan at 541-452-7172 or at mbryan@nuscalepower.com.

Sincerely,

Jennie Wike
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Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 9362

Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 9362

NuScale Power™

Response to Request for Additional Information
Docket No. 52-048

eRAI No.: 9362
Date of RAI Issue: 03/29/2018

NRC Question No.: 03.08.02-15

Follow-up to RAI 8858, Question 03.08.02-1

10 CFR 52.47, "Contents of applications; technical information," requires the design certification applicant to include a description and analysis of the structures, systems, and components with sufficient detail to permit understanding of the system designs.

In relation with RAI 9315, Question 03.08.02-14, the DCD should be updated to include a drawing that clearly shows entire CNV pressure boundary, showing how it extends beyond the main CNV body to include the ECCS trip and reset solenoid valve assembly.

NuScale Response:

This response addresses the original RAI question as well as follow-up NRC staff questions from public calls on 4/17/18 and 5/2/18.

Figure 3.8.2-10 has been added to FSAR Tier 2, Section 3.8.2 to identify the containment vessel (CNV) pressure boundary and reactor coolant pressure boundary (RCPB) for the emergency core cooling system (ECCS) trip/reset actuator valve. The figure shows that the CNV penetration and safe end contain two small hydraulic tubing lines 1/2 inch diameter or less inside of the penetration. These hydraulic lines connect to the valve body at the end of the safe end. The tubing wall forms the RCPB and the penetration and safe end form the CNV pressure boundary. No hydraulic tubing lines extend past the safe end. Reactor coolant system (RCS) fluid enters the ECCS trip/reset actuator valve, which is attached outside of containment, through the hydraulic line. Fluid in the hydraulic lines connected to the valve is a static flow path during operation and are not subject to RCS transient conditions. Flow only occurs in the hydraulic lines when the ECCS valves open and pressure in the lines is vented through the ECCS trip/reset actuator valve and into containment. When the ECCS trip/reset actuator valve is closed the CNV pressure boundary stops at the valve attachment weld and the ECCS trip/reset actuator valve forms the RCPB. When the ECCS trip/reset actuator valve opens the valve is open to containment and the valve then forms the CNV pressure boundary. The ECCS trip/reset actuator valve is evaluated to the same American Society of Mechanical Engineers

(ASME) Boiler and Pressure Vessel Code (BPVC) Class 1 requirements as the CNV and reactor pressure vessel.

The 2 small tubes connected to the ECC trip/reset actuator valve are attached by a socket weld. Access to the valve after it is attached would be through the nozzle/safe end opening, which is less than 3 inches in diameter and greater than 10 inches deep. Because of this limited access, attachment of the tubes to the valve will need to be welded to the valve prior to installation. There will be no heat affected zone impacting the valve to safe end attachment weld. During fabrication the attachment weld between the ECCS trip/reset actuator valve and the safe end will be examined per the requirements of NB-5200. This subarticle requires volumetric examination of the attachment weld by radiography followed by either liquid penetrant or magnetic particle examination. The weld processes typically used to join piping in this configuration are low-heat input processes reducing the size of the heat affected zone to generally less than 1/16” to 1/8” from the weld toe. Because the tubing connection location from this well is more than 2 times this distance there will be no heat affected zone impact of the valve to safe end attachment weld to tubing connection. Additionally, the valve body is made from low carbon austenitic stainless steel. The combination of low heat input weld processes and low carbon austenitic stainless steel base material mitigates the risk of flaw initiation and propagation.

The CNV penetration and safe end do not carry fluid to the valve, but house the small diameter hydraulic tubing, which carries the RCS fluid to the valve. The valve sits in the reactor pool at a relatively constant temperature so there are very few conditions which create any thermal transient condition on the inside of the penetration and safe end. Any initiation of internal cracking as a result of thermal loading at the valve-to-safe end weld is not expected. Any mechanical loading at the valve-to-safe end weld would be the result of valve displacement, such as due to a seismic event. This type of loading would create the largest stress at the outside surface of the weld. Any potential initiation of cracking would be expected to occur on the outer surface. Therefore, the inservice surface examination requirement specified by ASME BPVC Section XI, Table IWB-2500-1 (B-J) for a circumferential weld less than Nominal Pipe Size (NPS) 4 is applicable and does not need to be augmented to also include a volumetric examination.

The ASME BPVC Article NB-2500 provides optional requirements for the material examination of the ECCS trip/reset actuator valve body and bonnet during fabrication. In ASME BPVC Subarticle NB-2510, Examination of Pressure Retaining Material, a surface examination may be used for forged or cast valve with an inlet size from NPS 2 up to and including NPS 4. No examination is required for valve inlets less than NPS 2. Since the ECCS trip/reset actuator valve has a small fluid inlet, and the line is a static line which typically has no flow or transients there is no mechanism to initiate cracks internal to the valve body or bonnet. Therefore the requirements permitting the use of a surface examination for the ECCS trip/reset actuator valve is acceptable.

Impact on DCA:

FSAR Tier 2, Section 3.8.2 has been revised as described in the response above and as shown in the markup provided in this response.

Reinforcement of the shell due to the EPA openings is provided by the nozzle and any additional thickness in the shell greater than the minimum wall thickness of the shell as calculated in accordance with ASME Code, Section III, Paragraph NB-3324. There are no external loads imposed by the electrical penetration assemblies on their corresponding CNV flange.

RAI 08.01-1S1

Electrical penetration assembly design, construction, testing, qualification, and installation are in accordance with IEEE Standard 317-1983 as endorsed by Regulatory Guide 1.63. Production and installation testing meet IEEE Standard 317-1983 criteria. This ensures that electrical penetration assembly mechanical integrity is maintained during normal and accident events, which may also include the electrical faulting of a conductor within that electrical penetration assembly. The electrical design and environmental qualification requirements for electrical penetration assemblies are addressed in Section 8.3 and Section 3.11, respectively.

RAI 03.08.02-1, RAI 03.08.02-2, RAI 03.08.02-7, RAI 03.08.02-9, RAI 03.08.02-10, RAI 03.08.02-11, RAI 03.08.02-12

3.8.2.1.7 Emergency Core Cooling System Trip/Reset Valve Penetrations

RAI 03.08.02-1, RAI 03.08.02-2, RAI 03.08.02-7, RAI 03.08.02-9, RAI 03.08.02-10, RAI 03.08.02-11, RAI 03.08.02-12

The ECCS valve trip/reset assembly penetrations and safe ends are welded to the external side of the CNV upper shell. Two reactor recirculation trip/reset valves, NPS 3 Sch. 160 penetrations are located at an elevation of 58'-11.9", azimuth 7 degrees and 353 degrees. Three reactor vent trip/reset valves, NPS 3 Sch. 160 penetrations are located at an elevation of 89'-6.85" and azimuth 68 degrees, 188 degrees and 308 degrees, and one reactor vent trip valve, NPS 3 Sch. 160 penetration is located at an elevation of 89'-6.85" and azimuth 200 degrees. The safe ends and the penetration nozzle-to-safe end welds are part of the CNV. The valve assembly is welded to the penetration nozzle safe end. The CNV boundary is at the valve assembly-to-safe end welds and the welds are part of the CNV.

RAI 03.08.02-15

The penetration and safe end for the ECCS trip/reset actuator valve does not carry fluid to the valve. Inside of the penetration and safe end is hydraulic tubing with RCS fluid from the ECCS main valve. Out of the valve and into the safe end is hydraulic tubing connecting to another trip/reset valve, and an opening that vents to containment when the valve trips. The hydraulic tubing extends the RCPB to the valve. The valve forms the RCPB during normal operation. Once the ECCS RVV and RRV trip the ECCS trip/reset actuator valve opens to containment. The valve is then open to the RCS and CNV and then becomes the containment pressure boundary. A discussion of the operation of the ECCS trip/reset actuator valve is provided in Section 6.3.2.2. Figure 3.8.2-10 shows the pressure boundaries on a simplified schematic of the ECCS trip/reset actuator valve on the safe end.

RAI 03.08.02-15

There is no piping attached to the ECCS trip/reset actuator valve outside of containment and only the small diameter tubing inside of containment. Per ASME BPVC Paragraph NB-1131 the boundary of a Class 1 vessel shall not be closer than a vessel than the first circumferential joint in welded connections, but does not restrict the boundary to be extended past the first welded connection. Since there is no piping connected to the valve outside of containment and only small diameter hydraulic tubing connected to the valve inside of containment the ECCS trip/reset actuator valve attachment weld to the safe end belongs to the CNV.

3.8.2.1.8 Attachments

RAI 03.08.02-1, RAI 03.08.02-2, RAI 03.08.02-7, RAI 03.08.02-9, RAI 03.08.02-10, RAI 03.08.02-11, RAI 03.08.02-12

The CNV provides lateral and vertical support to the RPV at four locations. Each RPV support rests on the RPV support ledge and is connected with a SB-637 UNS N07718 six-inch diameter, 8 threads per inch (6-8 UN 2A) stud, nut, and washer. The connection is a slotted hole to allow for radial growth of the RPV and the stud prevents lateral motion in the support. The CNV boundary includes the RPV support ledge and attachment weld up to the support surface. The attachment stud and nut are part of the CNV.

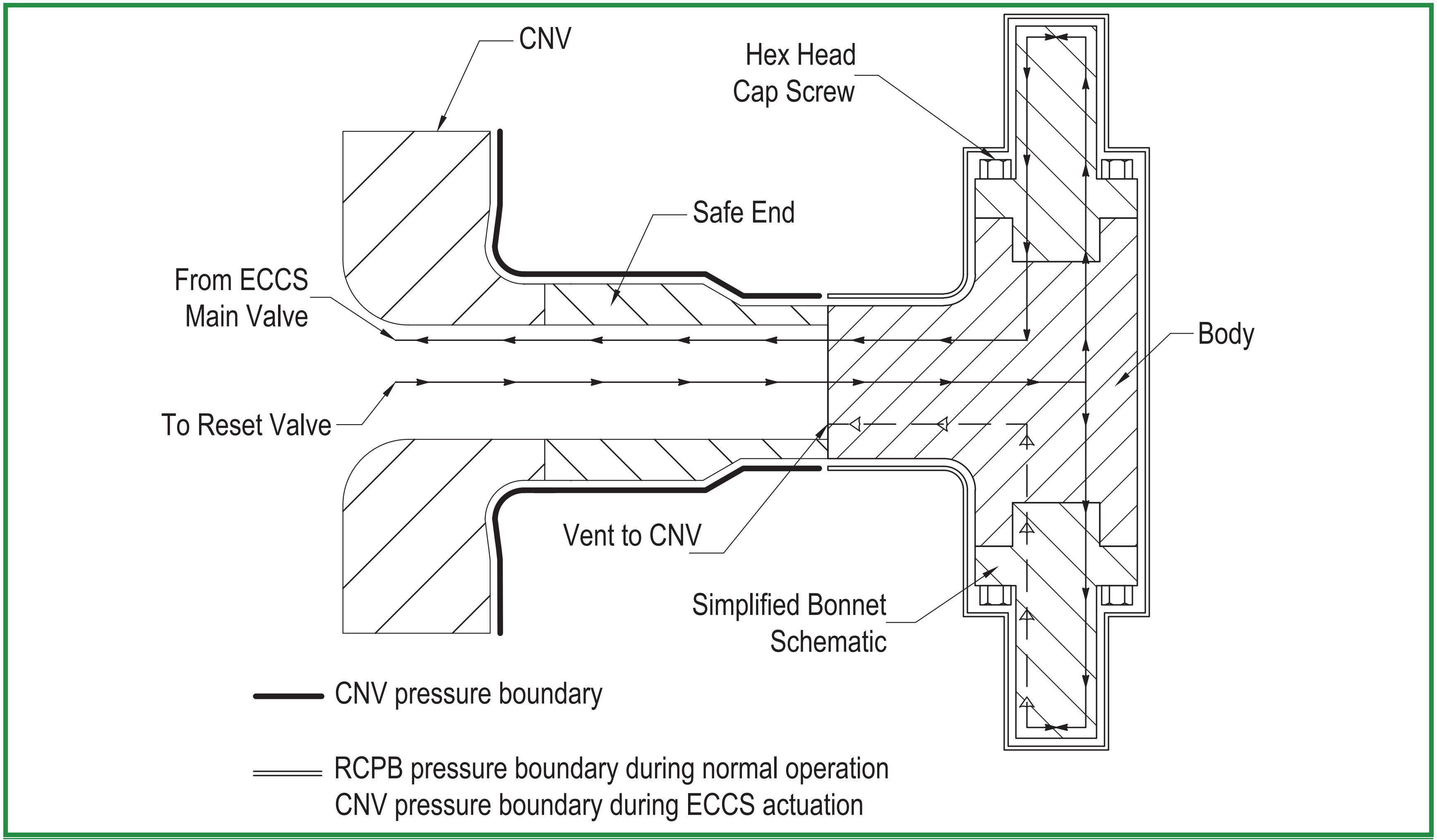
Lateral support of the RPV is provided at the CNV inside surface at the bottom of the CNV by an integral guide support. The guide support allows free vertical motion of the RPV, but prevents lateral motion. The CNV boundary is located at the face of the guide support.

Lateral support of the CRDMs is provided by the CNV at the inside diameter of the CRDM access opening in the CNV top head. The CRDM support frame consists of four pieces equally spaced around the opening at azimuth 45 degrees, 135 degrees, 225 degrees, and 315 degrees. Each piece of the frame is welded to the CNV shell and the CRDM access nozzle with full-penetration welds. For the purposes of the CNV, the CRDM support frame is a nonstructural attachment in accordance with ASME Code, Section III, Subarticle NE-1130 because it is not pressure retaining and does not contribute to support of the CNV. The boundary is at the surface of the CNV shell and the weld between the CRDM support frame and the CNV shell is considered part of the attachment.

Various other items are attached to the interior and exterior of the CNV (e.g., decay heat removal system passive condensers, piping supports, access platforms and ladders, and instrument enclosures). For the purposes of the CNV, these items are nonstructural attachments in accordance with ASME Code, Section III, Subsubarticle NE-1130 because they are not pressure retaining and do not contribute to support of the CNV. The boundary is at the surface of the CNV shell and the weld between the attachment and the CNV is considered part of the attachment.

RAI 03.08.02-15

Figure 3.8.2-10: ECCS Trip/Reset Actuator Valve Pressure Boundary



NuScale Power

Response to Request for Additional Information
Docket No. 52-048

eRAI No.: 9362
Date of RAI Issue: 03/29/2018

NRC Question No.: 03.08.02-16

Follow-up to RAI 8858, Question 03.08.02-3

10 CFR 50, Appendix A, GDC 2 requires systems, structures, and components important to safety be designed to withstand appropriate combinations of the effects of normal and accident conditions with the effects of natural phenomena including earthquake. TR-0916-51502-P, “NuScale Power Module Seismic Analysis,” Rev. 0, Section 8.4.3, “NuScale Power Module Seismic Analysis Results,” describes the calculated displacement and acceleration time-histories, maximum relative displacements, in-structure response spectrum, and maximum forces and moments at representative component interfaces.

NuScale response to RAI 8911, Question 03.09.02-46, regarding nuclear power module (NPM) damping is currently expected 11/26/2018. Since this value would affect the seismic model used to generate loads on the containment vessel, it would also affect the conservatism of the CNV Limiting Level D stress intensities. The staff understands that the updated damping values will be available by the end of July 2018.

Following a review of the damping values, the staff requests NuScale to update the CNV Stress Report and inform the staff when completed, after which, the staff will perform an audit to review the CNV Limiting Level D stress intensities to make an assessment on ASME conformance.

NuScale Response:

The preliminary revised seismic loads at the containment vessel (CNV) and reactor vessel (RPV) interfaces, CNV supports and CNV elevations have been evaluated and indicate that almost all seismic loads have been reduced. The few exceptions that slightly increased have significant margin to the allowable stress limit, and the load direction that increased produces only a portion of the stress, while the other directions have reduced. Seismic loads on the CNV safe ends and nozzles are not produced in the seismic load calculation. These loads are produced by the piping analyses, which use the the seismic response at the piping terminal ends and supports. A preliminary review of the revised seismic response spectra show most acceleration peaks have reduced. Based on the review of the preliminary revised seismic loads the current CNV primary stress calculation produces a bounding evaluation of CNV primary stress.

The CNV primary stress calculation has been reviewed by the NRC for the methodology used to evaluate primary stress on the CNV, which includes evaluation of the seismic load. The CNV primary stress calculation is a required analysis to meet the Section III, Subsection NB Class 1 limits of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (BPVC). FSAR Tier 1 Section 2.1.1 specifies the Nuscale Power Module ASME Code Class 1 and 2 components conform to the rules of construction of ASME Code Section III. FSAR Table 2.1-4, Item 2 specifies an Inspection, Test, Analysis and Acceptance Criteria (ITAAC) design commitment that the NuScale Power Module ASME Code Class 1 and 2 components conform to the rules of construction of ASME Code Section III. The primary stress calculation uses the loads in the CNV design specification that the CNV will operate to. The CNV will be N-stamped to these design specification loads, and the ASME BPVC design report is the confirmation showing that the CNV is in compliance with the ASME BPVC requirements. Therefore, revision and review of the CNV primary stress calculation at this time for revised DCA seismic loads is not needed because this analysis will be revised as part of the ASME design process outlined above and addressed through the existing ITAAC.

Impact on DCA:

There are no impacts to the DCA as a result of this response.

NUSCALE POWER

Response to Request for Additional Information
Docket No. 52-048

eRAI No.: 9362
Date of RAI Issue: 03/29/2018

NRC Question No.: 03.08.02-17

Follow-up to RAI 8858, Question 03.08.02-8

In accordance with GDC 50 and 10 CFR 50.44, the reactor containment structure, including access openings, penetrations, and the containment heat removal system shall be designed so that the containment structure and its internal compartments can accommodate, without exceeding the design leakage rate and with sufficient margin, the calculated pressure and temperature conditions resulting from any loss-of-coolant accident.

In response to RAI 8858, Question 03.08.02-8, the applicant stated that, "during the hydrostatic test, the joints, connections, and regions of high stress, such as around openings and thickness transition sections, are examined for leakage. The CNV design specification does not allow for leakage, including gasketed joints." However, ASME BPVC NB-6111 states, "Bolts, studs, nuts, washers, and gaskets are exempted from the pressure test. As the requirement in the CNV design specification specifies no leakage, including gasketed joints, add the hydrostatic test acceptance criteria from the CNV design specification to Tier 1, especially the portions that state that no leakage is allowed, including gasketed joints.

NuScale Response:

The American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (BPVC), Paragraph NB-6224 specifies for hydrostatic testing that all joints, connection, and regions of high stress shall be examined for leakage. Leaks from permanent seals, seats, and gasketed joints in components are only permitted when specifically allowed by the design specification. Leakage from temporary gaskets and seals is permitted. The containment vessel design specification does augment the ASME BPVC requirements in NB-6224 specifying no leakage is permitted, which would include temporary gasketed joints.

Application of an N-stamp to the containment vessel is confirmation that an Authorized Nuclear Inspector has witnessed the hydrostatic test and that no leakage has occurred from the permanent gasketed joints and that the requirements of ASME BPVC Article NB-6000 and containment vessel design specification have been satisfied. Therefore, inclusion of this requirement in Tier 1 of the FSAR is already addressed by ITAAC 02.01.02.

Impact on DCA:

There are no impacts to the DCA as a result of this response.